CLAIMS:

1. An electrode for fuel cell comprising a porous electron-conductive material carrying a catalyst,

wherein a proton-conductive substance is arranged on a surface, including surfaces of pores, of the porous electron-conductive material or in the vicinity of the surface; and

the proton-conductive substance is obtained by carrying out coupling or polymerization of a proton-conductive substance precursor, a proton-conductive monomer or an equivalent thereto on the surface or in the vicinity thereof.

2. The electrode for fuel cell according to claim 1, wherein the catalyst is a noble metal catalyst.

3. The electrode for fuel cell according to claim 1 or 2, wherein the catalyst is Pt or Pt-Ru.

4. The electrode for fuel cell according to any one of claims 1 to 3, wherein the porous electron-conductive material is a carbon-based porous electron-conductive material.

5. The electrode for fuel cell according to any one of claims 1 to 4, wherein the carbon-based porous electron-conductive material is selected from the group consisting of carbon black, acetylene black, graphite, carbon fiber, carbon nanotube, fullerene, activated carbon, and glass carbon.

6. The electrode for fuel cell according to any one of claims 1 to 5, wherein the pores have the average diameter of 10 μm or less.

7. The electrode for fuel cell according to any one of claims

1 to 6, wherein the proton-conductive substance is not caused to flow out by a cell power generation operation from the surface of the porous electron-conductive material or in the vicinity thereof.

8. The electrode for fuel cell according to any one of claims 1 to 7, wherein one end of the proton-conductive substance is bound to the surface of the porous electron-conductive material through a chemical bond.

9. The electrode for fuel cell according to any one of claims 1 to 8, wherein the proton-conductive substance has a sulfonic group ($-SO_3H$), a phosphoric group or a carboxyl group.

10. The electrode for fuel cell according to any one of claims 1 to 9, wherein the proton-conductive substance is a proton-conductive polymer having a sulfonic group ($-SO_3H$), a phosphoric group or a carboxyl group.

11. The electrode for fuel cell according to any one of claims 1 to 10, wherein the proton-conductive substance has a hydrophobic site, and the substance is adsorbed in a hydrophobic manner to the surface of the porous electron-conductive material via the hydrophobic site.

12. The electrode for fuel cell according to any one of claims 1 to 11, wherein the proton-conductive substance is a proton-conductive polymer, the polymer having a hydrophobic site and the polymer being adsorbed in a hydrophobic manner to the surface of the porous electron-conductive material via the hydrophobic site.

13. A fuel cell having an electrode for fuel cell according

to any one of claims 1 to 12.

14. A solid polymer fuel cell having an electrode for fuel cell according to any one of claims 1 to 12.

15. A direct methanol solid polymer fuel cell having an electrode for fuel cell according to any one of claims 1 to 12.

16. A method for producing an electrode for fuel cell, comprising the steps of:

a) causing a catalyst to be carried on a porous electron-conductive material;

b) forming a proton-conductive substance on a surface, including surfaces of pores, of the porous electron-conductive material or in the vicinity thereof; and

c) transforming the porous electron-conductive material into an assembly,

wherein the steps can be changeable in the order thereof.

17. A method for producing an electrode for fuel cell, comprising the steps of:

a) causing a catalyst to be carried on a porous electron-conductive material;

thereafter, b) forming a proton-conductive substance on a surface, including surfaces of pores, of the porous electron-conductive material or in the vicinity thereof; and

then c) transforming the obtained porous electron-conductive material into an assembly.

18. A method for producing an electrode for fuel cell, comprising the steps of:

a) causing a catalyst to be carried on a porous

electron-conductive material;

thereafter, c) transforming the obtained porous electron-conductive material into an assembly; and

then, b) forming a proton-conductive substance on a surface, including surfaces of pores, of the obtained porous electron-conductive material or in the vicinity thereof.

19. A method for producing an electrode for fuel cell, comprising the steps of:

b) forming a proton-conductive substance on a surface, including surfaces of pores, of a porous electron-conductive material or in the vicinity thereof;

thereafter, a) causing a catalyst to be carried on the obtained porous electron-conductive material; and

then c) transforming the obtained porous electron-conductive material into an assembly.

20. A method for producing an electrode for fuel cell, comprising the steps of:

b) forming a proton-conductive substance on a surface, including surfaces of pores, of a porous electron-conductive material or in the vicinity thereof;

thereafter, c) transforming the obtained porous electron-conductive material into an assembly; and

then, a) causing a catalyst to be carried on the obtained porous electron-conductive material.

21. A method for producing an electrode for fuel cell, comprising the steps of:

c) transforming a porous electron-conductive material

into an assembly;

thereafter, a) causing a catalyst to be carried on the porous electron-conductive material, which is a part of the assembly; and

then, b) forming a proton-conductive substance on a surface, including surfaces of pores, of the porous electron-conductive material or in the vicinity thereof.

22. A method for producing an electrode for fuel cell, comprising the steps of:

c) transforming a porous electron-conductive material into an assembly;

thereafter, b) forming a proton-conductive substance on a surface, including surfaces of pores, of the obtained porous electron-conductive material, which is a part of the assembly, or in the vicinity thereof; and

then, a) causing a catalyst to be carried on the porous electron-conductive material.

23. The method according to any one of claims 16 to 22, wherein the step b) has a modification step of modifying the surface of the porous electron-conductive material.

24. The method according to any one of claims 16 to 23, wherein the modification step is inserted before the proton-conductive substance is disposed on the surface, including surfaces of pores, of the porous electron-conductive material or in the vicinity thereof.

25. The method according to any one of claims 16 to 24, wherein the step of forming a proton-conductive substance is a step in

which a methylol group is introduced onto the porous electron-conductive material and the methylol group is reacted with a proton-conductive substance precursor, to form the proton-conductive substance.

26. The method according to any one of claims 16 to 25, wherein the catalyst is a noble metal catalyst.

27. The method according to any one of claims 16 to 26, wherein the catalyst is Pt or Pt-Ru.

28. The method according to any one of claims 16 to 27, wherein the porous electron-conductive material is a carbon-based porous electron-conductive material.

29. The method according to claim 28, wherein the carbon-based porous electron-conductive material is selected from the group consisting of carbon black, acetylene black, graphite, carbon fiber, carbon nanotube, fullerene, activated carbon, and glass carbon.

30. The method according to any one of claims 16 to 29, wherein the pores have the average diameter of 10 μm or less.

31. The method according to any one of claims 16 to 29, wherein the proton-conductive substance is not caused to flow out by a cell power generation operation from the surface of the porous electron-conductive material or in the vicinity thereof, especially from inside the pores.

32. The method according to any one of claims 16 to 31, wherein one end of the proton-conductive substance is bound to the surface of the porous electron-conductive material through a chemical bond.

33. The method according to any one of claims 16 to 32, wherein the proton-conductive substance has a sulfonic group ($-SO_3H$), a phosphoric group or a carboxyl group.

34. The method according to any one of claims 16 to 33, wherein the proton-conductive substance is a proton-conductive polymer having a sulfonic group ($-SO_3H$), a phosphoric group or a carboxyl group.

35. The method according to any one of claims 16 to 34, wherein the proton-conductive substance has a hydrophobic site, and the substance is adsorbed in a hydrophobic manner to the surface of the porous electron-conductive material via the hydrophobic site.

36. The method according to any one of claims 16 to 35, wherein the proton-conductive substance is a proton-conductive polymer, the polymer having a hydrophobic site and the polymer being adsorbed in a hydrophobic manner to the surface of the porous electron-conductive material via the hydrophobic site.

37. A method for producing a fuel cell, comprising the steps of:

using electrodes for fuel cell obtained with a method according to any one of claims 16 to 36 as a cathode and/or an anode; and

arranging the cathode and/or the anode so as to sandwich an electrolyte therebetween.

38. The method according to any one of claims 16 to 37, wherein the assembly is a catalyst layer formed on one or both of the electrodes for fuel cell.